DOCUMENT RESUME

ED 355 427 CE 063 313

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TITLE Vocational Assessment of Students with Disadvantages: Their Peculiar Needs.
PUB DATE Dec 92
NOTE 10p.; Paper presented at the Annual Convention of the American Vocational Association (St. Louis, MO, December 4-8, 1992).
PUB TYPE Reports - Research/Technical (143)

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS Blacks; *Educationally Disadvantaged; *Evaluation Methods; Females; High Schools; *High School Students; Learning Disabilities; Males; Student Evaluation; Test Bias; *Test Reliability; Vocational Aptitude; *Vocational Evaluation; Whites; *Work Sample Tests
IDENTIFIERS *Akron Public Schools OH

ABSTRACT

A study examined the underlying factor structure of the aptitude tests and work samples being completed by students with educational disadvantages (limited reading and mathematics skills) who were assessed with the current assessment model in the Akron (Ohio) Public Schools. The amount of variance accounted for by the factors was also investigated, and clarification was sought to determine if any differentiation exists between races and between sexes on the assessment measures. The assessment battery studied included the following: Apticom Computerized Aptitude and Interest Assessment; Valpar Worksample 8, Simulated Assembly; and Valpar Worksample 6, Independent Problem Solving. Assessments were completed in the students' home schools, with two students tested simultaneously, switching positions at the halfway point. The study found that the abbreviated vocational evaluation battery is well accepted by students and that it provides adequate information to initiate vocational planning. The battery meets the needs of the school in that it assesses students quickly and is completed in one administration. The factor structure obtained suggests that this battery does a good job of measuring vital vocational skills. However, results could have been skewed by the referral process that may have provided more white male students than minority and female students and by the fact that the students assessed were in danger of dropping out. Further research to determine the impact of race and gender is suggested. (Contains 15 references.) (KC)

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ED355427

VOCATIONAL ASSESSMENT OF STUDENTS WITH DISADVANTAGES: THEIR PECULIAR NEEDS

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Abstract

This study attempted to examine the rational and components of a shortened assessment battery for secondary students with disadvantages. The assessment battery included the Apticom Computerized Aptitude and Interest Assessment; Valpar Worksample #8, Simulated Assembly; and Valpar Worksample #6, Independent Problem Solving. Differences between subtest mean scores by sex and by race were reviewed. A factor analysis revealed four factors within the assessment battery. These include cognitive skills/general intelligence, perceptual motor skills, clerical skills and visual-motor coordination. The factor structure, as expected, holds together.

Introduction

Little has been documented in the literature regarding the vocational assessment of students with disadvantages since the early 1970's. The term disadvantaged refers to individuals who have economic or academic disadvantages and who require special services and assistance in order to enable them to succeed in vocational education programs. The term includes individuals who are members of economically disadvantaged families, migrants, individuals who have limited English proficiency, and individuals who are dropouts from, or who are identified as potential dropouts from, secondary school. (Federal Register, August 16, 1985 p. 33233).

Numerous references can easily be obtained regarding vocational assessment of adults and students with disabilities. Moed (1960) and Neff (1968) identified five different vocational evaluation approaches which are utilized by vocational evaluators in rehabilitation facilities. These include:

- Psychological Testing Approach
- Job Analysis Approach
- Worksample Approach
- Situational Assessment Approach
- Job Tryout Approach

Nadolsky (1971) reviewed many of the manpower training programs from the 1960's and 1970's in his study to develop a model for vocational evaluation of individuals with disadvantages that was consistent with practices of vocational evaluators employed in rehabilitation and manpower training programs. Nadolsky's general assessment findings can be summarized below:

- Most psychological tests are not appropriate
- Relationship between test scores and general occupational requirements should be stressed
- Emphasize positive aspects of worksample results and compare performance on worksamples within different occupational areas
- Worksamples are practical, realistic assessments of job skills and provide immediate feedback

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- Situational assessment is most effective if monetary rewards are provided
- Job tryouts used only after vocational planning from other assessments

The above constraints are compounded when you also add the component that the individual with the disadvantage is a secondary school student.

The Carl D. Perkins Vocational Education Act Amendments of 1984 required that disadvantaged students be provided a vocational assessment at least one year prior to eligibility to enter vocational education programs. The most current reauthorization, the 1990 Carl D. Perkins Vocational and Applied Technology Education Act, continues to designate a major portion of its funds for individuals with disadvantages. Vocational assessment is included in this legislation.

It is well documented that students with disadvantages do not score well on readily available formal tests of intellectual skills (Karp and Sigel, 1965; Society for Psychological Study of Social Issues, 1964). Students with disadvantages have more difficulty with reading, communication and other skills (Wircenski, 1985). The American Psychological Association Task Force on Employment Testing of Minority Groups (1969) found that students with disadvantages score substantially lower than others on nearly all aptitudes.

Freeberg (1970) acknowledged these assessment difficulties and attempted to create alternative assessment measures for students with disadvantages. He acknowledged that the assessment must address:

- Administration format - presentation style or appeal is important to consider
- Verbal content - maximum difficulty at the 5th grade reading level
- Pictorial content - to enhance test taking motivation
- Test length - test taking attention span in relatively short

Smith (1990) also acknowledges physical characteristics of the student with disadvantages:

- Rapid physical growth - metabolic changes result in increased food and rest consumption
- Grow of the mind - changes from concrete to abstract logic
- Search for identity - self concept as a learner develops
- Development of social skills - learning psychosocial roles

Beyond all of these accommodations which must be made in attempt to assess this population, working with disadvantaged students also requires motivating them to remain in school, identifying and removing barriers to student success, and providing basic skills remediation, support services, quality vocational training programs, and timely opportunities for students to utilize new occupational skills (Dunn, 1987).

Wircenski (1985) notes that there must be a viable, organized system for identifying the skills and abilities of each student with disabilities in the primary and middle school years. He goes on to state that the assessment must be on-going into the high school years. The assessment should include a complete review of the student's academic skills, learning styles, communication skills, aptitudes, vocational interests, family economic conditions, and social adjustment skills.

The student factor adds unique criteria for the vocational assessment. These characteristics are summarized below:

- Large numbers of students must be assessed as rapidly as possible to limit time away from classes.
- Due to attendance problems assessment must be completed in one sitting.
- Assessments must provide implications for relevant local training programs and locally available employment opportunities.
- Assessments must be completed at the eighth to ninth grade level in order to implement plans that address the scope of services needed at the secondary level.
- Assessments must be in a form that addresses the limitations of students with disadvantages (i.e. limited reading and math skills).
- Assessment data must be presented to the student and appropriate school and community staff and family members that is understandable and relevant to the local employment market.
- Assessments must address prevocational skills such as on-task behaviors and school attendance.

In combination, these factors document a definite need for development and documentation of a workable model for vocational assessment of students that are disadvantaged in secondary schools.

Purpose

The purpose of this study was to examine the underlying factor structure of the aptitudes and worksamples being completed by the students being assessed with the current assessment model in Akron Public Schools, Akron, Ohio. Further, the amount of variance accounted by the factors was sought to be determined. Clarification was sought to determine if any differentiation exists between races and between sexes on the assessment measures.

Method

During the last four school years; 1988-1989, 1989-1990, 1990-1991, and 1991-1992; students in the Occupational Work Adjustment (OWA) classes in Akron Public Schools have completed a vocational assessment battery. Students in OWA are generally in the ninth grade, although a small number of tenth graders may also be in this program. Potential students are usually referred by the eighth grade counselors for the OWA program. OWA students meet the disadvantaged classification by exhibiting behaviors that cause them to be high risk for dropping out of school. Generally, attendance and/or school behavior problems are prominent in the years prior to ninth grade. Another reason for OWA placement might be economic need for employment. OWA students are in school each morning and are employed in the afternoons. Employment is a requirement of the program. There is at least one OWA program in each of the eight comprehensive high schools in Akron.

File records have been maintained for each OWA student completing vocational assessment. This study involved only nonreactive file review measures.

There are 481 complete assessments in this study. 38% (N=183) of the students were African-American. 61.3% (N=295) of the students were Caucasian, and .6% (N=3) were of other racial backgrounds. 69% (N=334) were male students and 31% (N=147) were female students. All students were enrolled in the OWA programs and met the definition of being either academically or economically disadvantaged. All students were in the ninth or tenth grade of school.

Instrumentation

The vocational assessment battery which was completed by the OWA students in Akron Public Schools included the Apticom Aptitude Battery; the Apticom Occupational Interest Inventory; Valpar worksample #8, Simulated Assembly; and Valpar worksample #6, Independent Problem Solving. There are 481 case files of students who completed this battery. There was no missing data in any student file.

The Apticom is a computerized assessment of an individual's vocational aptitude skills and vocational interests. According to Bottenbusch (1987), the Apticom system was designed for disadvantaged job applicants, high school or special education students, and rehabilitation clients. There are eleven subtests in the aptitude assessment ranging in length from 45 seconds to 7 minutes to complete. Test taking attention span is a factor which must be addressed with this population. The aptitude assessment can generally be completed in approximately 45-60 minutes. The individual uses a probe to select the correct answer on the electronic board format. A forced choice format is utilized. Hardware is utilized for the eye-hand-foot coordination subtest and the finger and manual dexterity subtests. The aptitudes are reported in standard scores.

The Apticom Occupational Interest Inventory is also a forced choice format. It consists of 162 items using a like-?-dislike format. This section requires 4-5 grade reading level. However, items may be read to the individual. It takes approximately 10-30 minutes to complete. A printed report is available immediately following administration. Analysis of the interest information is not included in this study.

The Apticom aptitude system is based on the U. S. Department of Labor definitions of ten of the eleven aptitudes (except color discrimination), with much of the design and test item format closely resembling those of the General Aptitude Test Battery (GATB).

Aptitude	Description
G - Intelligence	General learning ability. The ability to "catch on" or understand instructions and underlying principles; the ability to reason and make judgments. Closely related to doing well in school.
V - Verbal	The ability to understand meaning of words and to use them effectively. The ability to comprehend language, to understand relationships between words, and to understand meanings of whole sentences and paragraphs.
N - Numerical	The ability to perform arithmetic operations quickly and accurately.
S - Spatial	Ability to think visually of geometric forms and to comprehend the two-dimensional representation of three-dimensional objects. The ability to recognize the relationships resulting from the movement of objects in space.
P - Form Perception	Ability to perceive pertinent detail in objects or in pictorial or graphic material. Ability to make visual comparisons and discriminations, to see slight differences in shapes and shadings of figures, and widths and lengths of lines.

Q - Clerical Perception	Ability to perceive pertinent detail in verbal or tabular material. Ability to observe differences in copy, to proof read words and numbers, and to avoid perceptual errors in arithmetic computation. A measure of speed of perception is required in many industrial jobs even when the job does not have verbal or numerical contents.
K - Motor Coordination	Ability to coordinate eyes and hands or fingers rapidly and accurately in making precise movements with speed. Ability to make movement response accurately and swiftly.
F - Finger Dexterity	Ability to move fingers and manipulate small objects with fingers, rapidly, and accurately.
M - Manual Dexterity	Ability to move hands easily and skillfully. To work with hands in placing and turning motions.
E - Eye-hand-foot Coordination	Ability to move the hand and foot coordinately with each other in accordance with visual stimuli.

The Apticom Aptitude Assessment consists of the following subtests. Following the subtest name is the aptitude(s) it measures and the length of the subtest. Notice that the subtests are fairly short, the longest being seven minutes. The number of items in a subtest is also noted.

Apticom Subtest	Aptitude	Subtest Length/Items
1 Object identification	P	1 min., 30 items
2 Abstract shape matching	P	2 min., 30 items
3 Clerical matching	Q	1 min., 30 items
4 Eye-hand-foot coordination	E	45 sec.
5 Patter visualization	S & G	5 min., 30 items
6 Computation	N	4 min., 30 items
7 Finger dexterity	F	2 min.
8 Numerical reasoning	N & G	7 min., 23 problems
9 Manual dexterity	M	2 min.
10 Word meanings	V & G	2 min., 15 sec.; 30 items
11 Eye-hand coordination	E	45 sec.

Two Valpar worksamples are also included in the Akron Public School assessment battery. These worksamples are based on a trait and factor approach taken from job analysis (Botterbusch, 1987).

Valpar worksample #8, Simulated Assembly, assesses the ability to perform a repetitive task requiring finger and manual dexterity. Two plastic washers are assembled onto a pin and placed into a rotating wheel. The more parts assembled the higher the score. Incorrectly assembled parts are not counted. The worksample is twenty minutes in length. Observations are made during the worksample regarding on-task skills, work method, fatigue, bimanual dexterity, and the ability to follow directions.

Valpar worksample #6, Independent Problem Solving, measures ability to perform tasks requiring the visual comparison and selection of abstract designs. The individual is presented with a set of fifty cards. Each card has five abstract designs of various primary colors. At the top of the worksample are three sample cards containing five abstract designs. The task is to compare the card to the corresponding sample card and check for abstract design color matches. If the match is

not present a mark must be made with a stylist on the perforated grid. Two scores are obtained. Speed of task completion is the quantity score. Errors made during completion is the quality score.

The two Valpar worksamples are reported in Method-Time-Measurement (MTM) percent scores. MTM is an industrial engineering acronym. According to Todd and Chyatte (1976), MTM is a discipline developed in the late 1940's to establish standards of normal performance, improve existing methods, and synthesize anticipated production. In the Valpar-spective (1976), MTM's were discussed in relation to theory and to practice. In theory, MTM is defined as a procedure which analyzes any manual operation or method into the basic motions required to perform it and assigns to each motion a predetermined time standard which is determined by the nature of the motion and the conditions under which it is made. In practice, MTM's provides an objectively-derived, entry-level production standard by which an evaluee's worksample performance can be compared. Percent rankings above 100 can be achieved. The MTM norm format accommodates performance up to and including 150 percent with 100 percent representing entry level job-readiness in terms of what the worksample is designed to measure.

Procedure

The assessments were completed in the student's home school. Two students were tested simultaneously. Each student verbally completed a short vocational interview with the vocational evaluator. Following the interview, one student initiated the Apticom subtests while the other student completed Valpar worksample #8 then Valpar worksample #6. The two students then switched positions and completed the other half of the assessment battery. The assessments were conducted during the morning school time as these students are assigned to work sites in the afternoon. The assessment required approximately 2 1/2-3 hours to complete for both students. The assessment was completed in entirety, thus not requiring the student to return for additional assessment time. Following completion of all students in the individual OWA class, test results were shared with the students and individual staffings were held to develop vocational plans.

Results

A factor analysis was performed in order to simplify the description of behaviors by reducing the categories to a few common traits. A principal component factor analysis was done in this case to determine the number of factors/concepts involved in the present battery. Only factors with eigenvalues greater than 1 were retained for interpretation. A correlation matrix using unities as estimates of communalities served as input.

Factor loadings are interpreted as correlation coefficients between the variable and the factor. The proportion of variance accounted for by a factor measures the overall correlation of the variables with the factor. Factor 1 accounted for 29.8% of variance with loadings ranging from .35 to .76. Loadings on Factor 2 ranged from -.55 to .49. Factor 2 accounted for 14.5% of variance. The third factor had loadings ranging from .05 to .60 and contributed 8.4% of variance. The forth factor contributed 8.1% of variance and had loadings of values from .04 to .51. (A summary of this analysis is available from the authors.)

Whereas unrotated factor loadings for each variable are dependent on all the variables in the analysis, in rotation the shift is from factors maximizing total variance to factors delineating separate groups of highly intercorrelated variables. A varimax rotation was performed and new factor loadings emerged. The rotated factor structure suggests that the battery content can be described by four constructs. Factor loadings with an absolute value of .44 are defined by the authors as meaningful and are presented in Table I. Inspection of significant item loadings suggested names for each factor which were descriptive of the skills and abilities involved in each measure. Items loadings on the first factor indicate that this is measuring general intelligence.

Factor 2 encompasses a perceptual motor component. Factor 3 measures clerical skill/attention to detail. The construct underlying factor 4 is visual-motor coordination.

Inspection of Table I shows that the numerical aptitude loads significantly on both factors 1 and 3 which is reasonable, considering the task involved. The numerical test is made up of a calculation component, involving clerical skills and attention to detail, and an applied problem component, requiring cognitive skills. The quantity score on Valpar worksample #6 loads negatively on both factors 2 and 4. This test encompasses both perceptual motor and visual motor skills. On this timed test, the lower the score the better.

A Hotelling's T^2 multivariate analysis was performed in order to determine if there were significant differences between two groups on one or more of thirteen dependent variables, after adjustment had been made for possible correlations among the variables.

The multivariate analysis of sex by race was not significant. However, Hotelling's T^2 on the two major racial groups differed significantly ($p=.000$) on at least one of the thirteen dependent variables. Table II shows means and standard deviations and also indicates that there were potentially seven measures where performance was significantly different. After controlling for multiple comparisons, five significant differences remain; general intelligence, verbal aptitude, numerical aptitude, the quality score on Valpar worksample #6 and the quantity score on Valpar worksample #8. The two groups performed similarly on the other eight measures.

The Hotelling's T^2 multivariate analysis of the effect of sex across the thirteen tests was also significant at .000. Inspection of the univariate F tests, given in Table III suggests that, after controlling for multiple comparisons, there were three measures which were statistically significant. For spatial and form perception aptitudes, males performed considerable superior to females. On clerical perception, female performance was significantly better. One other test, the quality score on Valpar worksample #6 approached significance, again with females having the highest scores. The two groups performed similarly on all other measures.

Discussion

This exploratory study has been an attempt to justify the abbreviated vocational evaluation battery. The authors feel that the abbreviated battery is well accepted by the students completing vocational assessment. It does provide adequate information to initiate vocational planning. The battery meets the needs of the school in that it assesses students quickly and is completed in one administration. The factor structure obtained suggests that this battery does a good job of measuring vital vocational skills.

Our sample is, of course, non-random and not representative. Subjects in this study were referred to the OWA program from a pool of eighth graders because they were believed to be potential drop outs or to have an economic need to work. Eighth grade counselors, from a variety of middle schools selected students for a variety of reasons. There are inequities in the percentage of male versus female referrals. Selection bias could be contributing to mean differences between groups. The discrimination between groups by sex and race may not be due to the test itself. Perhaps brighter male students, who have difficulty focusing on traditional subject matter are referred while their female counterparts are not. Minority students and females may be screened out because they are seen as being served better in more traditional academic environments.

The obtained factor structure holds together well. The abbreviated battery appears to adequately measure cognitive, perceptual-motor, clerical, and visual-motor skills. Even though this factor structure makes sense, it may be unique to the age and ability of the sample, which was young, unskilled, and inexperienced. We did not begin this exploratory study with a random or representative population. The present sample, with experience, may have yielded a somewhat

different factor structure. Also a random sample, given the same battery may have broken out the factor structure somewhat differently.

In interpreting the assessment results, clinical judgement should always be utilized in addition to the resulting test scores. These scores should be used as a component in the determination of a student's vocational goals. Judgement regarding program selection should not be made on the basis of any single score. Test scores may be used in association with observational reports from other sources and may be weighted by professional judgement along with a variety of input from various sources.

Implications

There are four major implications for further research. First, the referral criteria needs to be investigated. Second, perhaps there is a need to have separate norms, by race and sex, which could be developed locally. National norms may discriminate inappropriately, if they are applied to samples of students such as those included in the present study. Third, the factor structure should be verified with other groups of subjects. Fourth, evaluators need to be aware of the problems in applying the usual interpretation of test data to nonrepresentative groups. Evaluators are encouraged to use their clinical judgement as well as test scores in making recommendations.

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Presentation made at American Vocational Association Conference, December 7, 1992, St. Louis, Missouri.